JOURNAL

OF THE

WASHINGTON ACADEMY OF SCIENCES

VOL. II, MARCH 19, 1912 No. 6

MINERALOGY.—*The crystallography of variscite.* WALDEMAR T. SCHALLER, Geological Survey.

In a recent publication[1] I gave a description of variscite crystals from Utah. All of the material then available showed the same crystal habit, a rectangular, tabular one which was illustrated by crystal drawings and by a photograph. Thru the kindness of Messrs. Edison and Bird, of Lucin, Utah, I have recently examined a larger number of specimens and found that the mineral crystallizes in several additional habits, such as very thin plates, long prisms and octahedral pyramidal crystals of which the unit pyramid {111} is the dominant form. Beautiful little twin crystals were also found in a measurable condition.

The number of crystal forms has been extended from the four given in the paper above cited to over fifteen. A full description of these crystals with their angular measurements is to be given in a paper nearly ready for publication.

MINERALOGY.—*New manganese phosphates from the gem tourmaline field of Southern California.* WALDEMAR T. SCHALLER, Geological Survey. To be published in a Geological Survey Professional Paper, entitled: "The Gem Tourmaline Field of Southern California."

The various properties of these new minerals and their relation to each other will be fully described in the report referred to above.

[1] Schaller, Waldemar T.: Crystallized Variscite from Utah. Proc. U. S. National Museum, 41: 413-430, plate. 1912.

All of these minerals were found at Pala, San Diego County, California.

*Palaite.*[1] Probably monoclinic. A flesh-colored hydrous manganese phosphate, resulting from the alteration of lithiophilite. D. 3.14 – 3.20; mean refractive index about 1.655, slightly lower than that of hureaulite; double refraction low. Forms crystalline masses in the cavities of which are found distinct crystals. In thin section colorless, and non-pleochroic. Formula $5MnO.2P_2O_5.4H_2O$, (Analysis 1). It alters to hureaulite. Found in the Stewart Mine at Pala, from which the name of the mineral is derived.

*Stewartite.* Probably triclinic. A hydrous manganese phosphate from the Stewart Mine, after which it is named. It is very abundant as an alteration product of lithiophilite which it replaces along its cleavage cracks. The first formation of stewartite is in fine fibers arranged normal to the cleavage cracks of the lithiophilite. Irregularly bounded areas and minute but distinct crystals of stewartite were also noted. The crystal form and optical properties of these minute crystals serve to characterize the mineral and to show that it cannot be identified with any known species. Altho abundant, it is so intermingled with the other minerals of similar composition that a pure sample of it, sufficient for quantitative analysis, could not be obtained. Its importance in the alteration of lithiophilite necessitates a name for the mineral which its physical properties suffice to establish. D. 2.94. Mean refractive index about 1.65. Double refraction very high, probably not under 0.05. Pleochroic: colorless, pale yellow, yellow. Extinction inclined on all crystal edges. Axial angle large, negative, dispersion strong. Probably the same as the unknown mineral "A" described by Lacroix.[2]

*Salmonsite.* Named after Mr. Frank A. Salmons, formerly of Pala, and found in the Stewart Mine. It results from the partial oxidation and hydration of hureaulite, and forms cleavable masses of a buff color, seamed by small veins of fibrous palaite and sprinkled with small masses of blue strengite. D. 2.88.

[1] Pronounced Pā-la-ite.

[2] Lacroix, A.: Mineralogie de la France, 4: part 2, p. 506. 1910.

Mean refractive index about 1.66, double refraction low. In thin section yellow and non-pleochroic. Formula $Fe_2O_3.9MnO.4P_2O_5.14H_2O$,(Analysis 2).

*Sicklerite.* Named after the Sickler family, formerly of Pala. Found in cleavable masses at the Vanderburg-Naylor Mine on Hiriart Hill near Pala. Dark brown color with a light yellow-brown streak. D. 3.45. Refractive indices about 1.74, double refraction moderate. Pleochroic in yellow and brown. Formula $Fe_2O_3.6MnO.4P_2O_5.3(Li,H)_2O$, (Analysis 3). Readily fusible before the blowpipe giving a lithium flame. Results from the alteration of lithiophilite.

In addition to the above named new minerals, there occur at Pala, associated with them, the following whose properties and relations to one another will be given in detail in the full report: lithiophilite, hureaulite, strengite (the same as the angelardite of Lacroix,[3]) triplite, purpurite,[4] manganite and psilomelane.

ANALYSES AND RATIOS OF NEW MINERALS

| | PALAITE | | SALMONSITE | | SICKLERITE | |
|---|---|---|---|---|---|---|
| | Analysis | Ratios | Analysis | Ratios | Analysis | Ratios |
| FeO | 7.48 | 5.00 | 0.13 | 9.18 | | |
| MnO | 40.87 | | 37.74 | | 33.60 | 6.28 |
| CaO | 1.77 | | 1.06 | | 0.20 | |
| $Fe_2O_3$ | 0.16 | | 9.53 | 1.00 | 11.26 | 1.09 |
| $Mn_2O_3$ | | | | | 2.10 | |
| $P_2O_5$ | 39.02 | 1.93 | 34.86 | 4.10 | 43.10 | 4.00 |
| $H_2O(110°)$ | | | 0.43 | | | |
| $H_2O+$ | 10.43 | 4.07 | 15.30 | 14.17 | 1.71 | 2.92 |
| $Li_2O$ | trace | | | | 3.80 | |
| Insoluble | 0.89 | | 1.40 | | 4.18 | |
| | 100.62 | | 100.45 | | 99.95 | |

[3] Loc. cit., p. 522.

[4] Compare this Journal, 1: 113. 1911.

PHYTOPATHOLOGY.—*An external dry rot of potato tubers caused by Fusarium trichothecioides*, Wollenw. C. O. JAMIESON and H. W. WOLLENWEBER, Bureau of Plant Industry. Communicated by C. S. Scofield.

Certain types of decay of potato tubers have been ascribed by various authors to the action of the fungus Fusarium (Clinton, 1895; Smith and Swingle, 1904). Conclusive infection experiments have been performed by several (Pizzigoni, 1896; Wehmer, 1897; Pethybridge and Bowers, 1908; Longman, 1909 and others).[1] In most cases *Fusarium solani* (Mart.), or a species thought to be a synonym of it, is said to be the real cause of the rot. The different kinds of decay described on the one hand, and the negative results often secured on the other, directed attention to a more complete study of the morphology of potato Fusaria and their differentiation. During this study, which was done in Germany, not less than fifteen species were isolated, of which nine have been published (Appel and Wollenweber, 1910). As a result of recent and as yet unpublished experiments at Dahlem-Berlin only two of the nine species have been found to be wound parasites of the stored tuber: *F. coeruleum* (Lib.); *F. discolor* var. *sulphureum* (Schlecht. s. sp.). Closely related to the latter is a new species, found in the United States and characterized by a peculiar injury known as external dry rot. This disease has been studied by Miss Jamieson during the past two years.

Attention was first called to the disease in February, 1910, in potato tubers sent from Spokane, Washington. Since then we have examined samples of similarly diseased tubers from the same locality, as well as from Iowa, Minnesota, Nebraska, and South Dakota. Symptoms of this disease have been noticed in the field at the time of harvesting potatoes, in one instance the estimated infection being about 10 per cent of the crop, but it is

[1] See also Appel and Kreitz. Der derzeitige Stand unserer Kenntnisse von den Kartoffelkrankheiten und ihrer Bekämpfung. Mitt. a.d. Kais. Biol. Anst. f. Land und Forstw., Heft 5, 1907. Berlin. (With lists of the more important references up to 1907), and Pethybridge and Bowers. Dry Rot of the Potato Tuber. The Economic Proceedings of the Dublin Society, vol. I, 14, 1908, p. 547–558. 1 Tab.

concerning the loss of potatoes in storage that complaint is most frequently heard.

Potatoes affected with this external dry rot are characterized by wrinkled, discolored, and somewhat sunken external spots, frequently but not always occurring at the "eye" end of the tuber, and varying in diameter from a few centimeters to several inches according to the progress of the disease. The color of these diseased areas is in general brownish, considerably darker than that of the normal epidermis and often having a slightly grayish cast. In a more advanced stage of the disease the epidermal tissue often breaks or cracks irregularly, exposing a substratum of fungus mycelium within. The surface of the tuber about the cracks may also be overgrown with a delicate pinkish-white, powdery growth, composed of fungus threads and spores. From sections made thru diseased tubers, the internal fleshy portion is seen to be seriously affected, often to a greater extent than is apparent from the external appearance. The internal discoloration is sepia brown, a cross section of a badly diseased potato often showing a pronounced contrast of shades varying from light to deep brown. As infection proceeds internal cavities are formed, from one to several centimeters in diameter, within which the fungus mycelium grows abundantly, presenting the same powdery appearance as noticed on the surface of the tuber. Gradually the whole substance of the potato becomes involved, until finally it is reduced to a dry, powdery, brownish-colored mass of broken-down cells, starch grains, fungus mycelium and spores. Tissue from various parts of infected tubers showed a fungus belonging to the genus *Fusarium* thruout the discolored portions as well as in the firmer tissue bordering upon these areas. A pure culture of this Fusarium was isolated from the inner tissue by the agar plate method. During our further investigations the same fungus has been isolated several times from dry-rot infected potatoes.

The following description and diagnosis of this Fusarium is now being added in the monograph of Dr. Wollenweber:

**Fusarium trichothecioides** Wollenw. In general appearance this fungus closely resembles *Trichothecium roseum* (Link); Conidia in nature as a rule not in sporodochia, but, in pure culture the

sporodochium or Pionnotes stage also occurs: Conidia of the former 1–3 septate, medium size, 15–26 x 4–5¼ microns, formed as a slightly curved comma, ellipsoidally rounded on both sides; conidia of the latter type 3–5 septate, 24–42 x 4½–5½ microns; form of the Discolor type. Conidia masses and plectenchyma salmon colored to carrot red when slightly moist, but lighter and usually rosy-white when powdery dry and intermixed with mycelium. Yellowish to brown stromata may be formed. Conidiophores of the comma type, mostly irregularly branched, with prominent sterigmata, the arrangement of which is scattered, or especially at the top, trifurcate. Conidiophores in the sporodochia more highly developed, like those of *F. discolor*. Chlamydospores seldom occur, and when present are intercalary, in chains or single.

Causes decay of potato tubers, especially under storage conditions. Diseased spots sepia-brown within. The early stage shows a very brownish black discoloration of the layer bordering the sound tissue. Spokane, Washington; St. Paul, Minnesota; Dayton, Iowa; Alliance, Nebraska; and Spearfish, South Dakota.

The two stages of conidial development above mentioned give this fungus an individual place in the genus. Less developed spores of other species may occur under abnormal conditions, but disappear when grown on a favorable host; but *F. trichothecioides* as a rule produces this smaller form abundantly both in nature and in pure culture. Spores of this stage resemble (Fig. A, E, F) exactly Trichothecium (Link) Corda, described and figured by Corda.[2] The sterigmata of the conidiophores, often trifurcate at the tops (Fig. C), seem to indicate a relationship to Basidiomycetes. Most important for the determination of the fungus, however, is the development of the higher type (Fig. B) in pure cultures. It forms salmon-colored sporodochia of the well known tubercularia-like type on the surface of sterilized, not too moist grains of cereals and mature stems of plants. The conidiophores of these sporodochia (Fig. D) are verticillately branched and show

[2] Icones fungorum, 1838, p. 10, cum tab., IX, fig. 48, 49.

a striking contrast to the smaller form (Fig. C). All the intermediate grades from the comma stage (like Trichothecium) to the sporodochia stage are easily produced by a selection of media. Beginning with the higher (sporodochia) stage we can reduce the fungus to the inferior (comma) stage by means of a transfer of mycelium; on the contrary, spores of the comma type once or repeatedly transferred on grains or stems, will give normal sporodochia with three to five-septate spores, sharply pointed at the ends (Fig. B).

The relationship to the discolor group may be determined only by the higher form; a confusion of the new fungus with *F. discolor* and its variety "*sulphureum*" is impossible because *F. discolor* differs by producing a purple mycelium, while that of "sulphureum" is brimstone-colored, and both differ from *F. trichothecioides* by the absence of the comma stage.

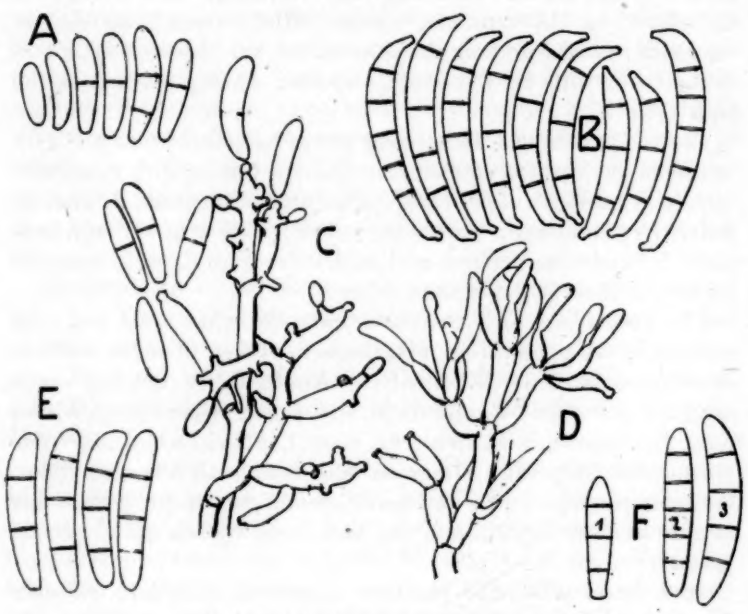
The occurrence of *F. trichothecioides* on other hosts is as yet unknown. A comparison with earlier studies of other authors shows that 5 different Fusaria cause similar tuber rots, 4 of which are fully described:[3] *F. solani* (Mart.), *F. coeruleum* (Lib.), *F. discolor* var. *sulphureum* (Schlecht. s. sp.), *F. trichothecioides* Wollenw. Probably Miss Longman[4] has dealt with a species different from the four. She names it *F. solani*, but to judge from her figures and her description, she had to do with a quite distinct species.

In order to prove the parasitic nature of *Fusarium trichothecioides*, inoculation experiments have been carried on under controlled conditions in our greenhouses during the past two seasons. Potato plants, grown in sterilized soil, from selected and disinfected seed were used, and pure cultures of *F. trichothecioides* inoculated into the stem just above the surface of the ground (Dec. 1910). In twelve days a wilting of the foliage was noticed accompanied by a yellowing of the leaves and a discoloration of

[3] Appel and Wollenweber: "Grundlagen einer Monographie der Gattung Fusarium (Link)," Bd. VIII, Heft 1, m., 10 Textfig., 2 schwarz., 1 farbig. Doppeltafel. Berlin: P. Parey u. J. Springer. 1910. Preis, 10 M.

[4] Longman, Sibyl: "The Dry-Rot of Potatoes," Linnean Society's Journal, Vol. XXXIX, Aug., 1909.

the tissue about the inoculation pricks. In three weeks time the fungus infection had produced a pronounced effect upon the plants, shown in the wilted condition of the foliage, in the constriction of the stem at point of inoculation, and in a brownish black




EXPLANATION OF THE FIGURE

A,E, F. Conidia of the comma-stage, grown on sterilized potato stems. $F_1$ seen from the back, $F_2$, $F_3$, extra large and highly septate. B. Conidia of the sporodochia-stage, grown on sterilized grains of corn (twenty days old). C. Conidiophore which in masses forms a dense growth on the surface of the medium like *Trichothecium roseum*, and produces spores shown in A, E. F. D. Conidiophore from a sporodochium, that forms the spore shown in B. Magnification 870.

discoloration of the tissue above and below the constriction. Upon the surface of the discolored area could be seen a growth of powdery slightly pinkish mycelium and spores. Microscopic examination and isolation showed this fungus to be *F. trichothe-*

*cioides*. Pure cultures of this same Fusarium were later obtained from tubers produced upon a plant diseased thru inoculation.

Further experiments are now being made to determine the most favorable conditions under which the infection of *F. trichothecioides* takes place. For this experiment sound healthy potato tubers of Burbank and Early Ohio varieties were selected, disinfected and placed in inoculation chambers. Two methods of inoculation were tried, one by stabbing the tuber with a thick needle and inserting fungus mycelium and spores from a pure culture of *F. trichothecioides*, the other by rubbing the surface with a platinum loop bearing the fungus. The ten inoculation chambers were then placed under different conditions of heat and moisture and examined at definite intervals. Thus far, results from this test indicate that of the two methods stabbing is the most effective, altho infection follows the rubbing of the fungus on the surface of the tubers. Discoloration of the tissue was noticed in the inoculation chambers after ten days and this was followed by a decay which penetrated into the tissue 2–3 cm. in twenty days. Rapid discoloration of the tissue was observed in both moist and dry chambers placed at a temperature of 10–12° C. In the drier atmosphere however, there was a deeper penetration of the decay into the tissue, than occurred at the same temperature under increased humidity. Two months after inoculation, the potato tubers were carefully examined and their appearance compared to the diseased specimens sent in from the field. Externally and internally the disease characteristics in field and laboratory specimens were similar. The brown grayish spots on the outside of the inoculated tubers frequently surround the "eyes," except in the case of the stab inoculations where the discoloration spreads about the wound. On the surface of the diseased tissue there is usually an abundant growth of pinkish powdery mycelium in the moist atmosphere, but very little of the external fungus growth in the drier air. The discoloration caused by the penetration of the fungus and extending several centimeters below the epidermis varies from light to dark sepia brown in color, the darkest portion forming a band which surrounds the cavities. In every

instance the decay appears to work from the surface inward. From results of this experiment it is clear that conditions of temperature and moisture undoubtedly play an important part in the beginning and in the progress of infection, and a better understanding of these conditions may prove of great value in attempting to control this dry rot disease especially among potatoes kept in storage.

## SUMMARY

1. *F. trichothecioides* Wollenw. is a wound parasite capable of destroying potato tubers.

2. This fact is proved by the inoculation experiments of Miss Jamieson.

3. This disease is clearly differentiated from the wilt and dry rot ascribed by Smith and Swingle to *Fusarium oxysporum* Schlecht.

# ABSTRACTS

**Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.**

METEOROLOGY.—*Free air data at Mount Weather for April, May and June*, 1911. WM. R. BLAIR. Bulletin, Mount Weather Observatory, 4: 144–181. 1911.

Ninety-three free air observations were made at Mount Weather in these three months, 65 by means of kites and 28 by means of captive balloons. One pilot balloon observation to the altitude of 2626 meters was made. The kites reached an average altitude of 3257 meters above sea level, the captive balloons, 2072. These observations have been reduced and the data tabulated in connection with weather notes made at the times of observations. Based upon these data charts have been made of the free air isotherms, two degrees apart, for the three months. The air temperatures observed during this period, near the earth's surface on the mountain and in the adjacent valleys, have been charted and discussed. It is concluded that the important factors in the determination of the temperatures observed at a station well out in the bottom of the Shenandoah valley are insolation and radiation; and that the temperatures observed at a station close to the foot of the mountain on the southeast side are those of air being transferred to and from the mountain top by convection currents. The latter temperatures are comparatively slightly modified by insolation and radiation at the observing station.

W. R. B.

METEOROLOGY.—*The height and temperature of the isothermal region at different latitudes and under different conditions.* W. J. HUMPHREYS. Bulletin of the Mount Weather Observatory, 4: 136–142. 1911.

The assumption that the height and temperature of the isothermal region are determined essentially by outgoing radiation has but one serious objection. This is, the fact that near the equator, where the surface temperature is highest, the isothermal region is not correspondingly warmer than elsewhere, as its winter to summer changes in middle latitudes would lead one to expect, but on the contrary much colder.

It is suggested that a greater prevalence of cirrus clouds in the equatorial regions than in other parts of the world (and observations indicate this inequality in their distribution) would largely account for the change with latitude of the temperature and height of the isothermal region. These clouds, whenever and wherever present, must act as a shield and partially protect the outer atmosphere from the radiation of lower levels, and thus allow it to grow colder through its own radiation to space. The somewhat entrapped heat below the tropical cirri must expand the atmosphere and thus increase its horizontal flow to higher latitudes where presumably there is less cirrus and freer direct radiation from the denser and lower atmosphere, and hence a warmer isothermal region.

W. J. H.

PHYSICS.—*Recent advances in high-temperature gas thermometry.* ARTHUR L. DAY. Trans. Faraday Society, London. **7**: 1911.

An address before the Faraday Society of London, reviewing the more important features of the recent work with the gas thermometer conducted at the Geophysical laboratory.

PHYSICS.—*The detection of small heat effects at high temperatures.* WALTER P. WHITE, Geophysical Laboratory. Physical Review, **32**: 604. 1911.

The general principle of the method is simple and fairly familiar. No moving bodies are present, and changes in the temperature of the charge are brought about solely by changing the furnace temperature. The heat effects in the charge are inferred from the changes in its temperature. The temperature of the charge thus depends upon two things: first, the furnace temperature, and second, the heat effects in the charge. The manipulation consists in observing the temperature rise, regulating the furnace current accordingly, and observing the temperature difference of furnace and charge.

The interpretation of the results may, in theory, be made very simple. The temperature gradient, $G$, between charge and furnace, serves as the measure of heat-flow to the charge. The flow actually is proportional to $G$, and to the heat-transmittance, $F$, of the space between furnace and charge. The exact values of both $G$ and $F$ are usually unknown, and may vary with time, temperature, rate of heating, etc., so that accurate heat determinations by means of them, tho possible, are quite difficult. But in the *detection* of a small heat effect we have merely to determine the change in $G$ caused by the addition of the effect to the heat which is required to change the temperature of the charge. For

instance, a silicate charge (2 grams) of specific heat 0.3, heated 10° per minute, lagged 3° behind the furnace ($G = 3°$). Hence 3° in $G$ corresponds to 3 calories per minute. If an inversion absorbing 3 calories and extending over 100° should occur, $G$ would be increased 0.1, or 0.3° for 10 minutes; if the inversion should take place in one minute, $G$ would be doubled, or increased 3°, etc. The detection of small heat-effects is easier: (1) The larger $G$ is, per calorie per minute, (2) the freer $G$ is from other variations, (3) the quicker the inversion occurs; it is only sluggish inversions whose detection gives any trouble.

$G$ increases with the furnace-rate; hence a rapid rate is of the first importance. $G$ also increases with the diameter of the charge, but can be made steadier in the case of a small charge, and the advantage of the small charge appears to be greater on the whole. Fluctuations in the furnace rate cause variations in $G$; these are partly eliminated by measuring $G$, not between charge and furnace, but between the charge and another body ("neutral body") closely resembling it. The apparatus now used is small, two platinum crucibles holding 1 cc. each, 3 mm. apart, and surrounded by a wider porcelain tube to increase uniformity of temperature. A differential thermo-element is also used, which gives directly the temperature difference of the two bodies at any instant. A complete platinum inclosure shields the whole system from leakage currents out of the furnace-coil. In one set of determinations made on different days with the same set-up, conditions were reproduced over a 300° interval with a maximum variation of from 0.03° to 0.06° in the different determinations. This was with a silicate charge and indicates that 1 calorie distributed over 100° could be detected. But this would be a more difficult case than has yet been found in practice. In one case it was observed that the first heating in each day which, of course, occurred immediately after the furnace had been cold, gave results differing by 0.3° from later heatings, altho the furnace was cooled 300° between all the heatings. This condition reproduced itself at 0.1° on successive days and could, therefore, be largely eliminated, but might prove decidedly deceptive if overlooked, and if the heat effect was, as happens, one occurring only in the first heating. W. P. W.

GEOCHEMISTRY.—*The geochemical interpretation of water analyses.* CHASE PALMER. Bulletin U. S. Geological Survey No. 479. Pp. 31. 1911.

This paper presents a statement of water analyses in purely chemical terms; a general chemical formula representing water character in terms of the proportional reaction capacity of the constituents; a similar but

simplified chemical formula based on groups of constituents and expressed in terms of properties of reaction; a purely chemical water-classification scheme based on the simplified formula; applications of the classification scheme and character formulas to the solution of practical geologic problems.

The analytical statement is an enumeration of the radicles in terms of reacting values (milligram-equivalents) as well as in parts per million, and these reacting values, when expressed as pecentages of their totality, constitute the general character formula. The radicles are segregated into their natural groups: Alkalies (represented chiefly by sodium and potassium); earths (represented chiefly by calcium and magnesium); a miscellaneous group of positive radicles represented chiefly by hydrogen, for which the group is named; strong acids (represented chiefly by chloride and sulphate); and weak acids (represented chiefly by carbonate and bicarbonate). Salinity (saltness) of water is a property such as is caused by the solution of salts of strong acids and alkalinity is a property such as is caused by the solution of salts of weak acids; but these general properties vary in nature in accordance with the proportions of the alkali, earth, and hydrogen groups in the salts. The simplified formula is, therefore, a statement (in per cent) of the proportional reaction capacity of five special properties, as follows: Primary salinity, salinity such as is caused by the solution of strong-acid salts of the alkali group; secondary salinity, salinity such as is caused by the solution of strong-acid salts of the earths group; tertiary salinity or persalinity, salinity such as is caused by the solution of strong-acid salts of the hydrogen group; primary alkalinity, alkalinity such as is caused by the solution of weak-acid salts of the alkali group; and secondary alkalinity, alkalinity such as is caused by weak-acid salts of the earths group. Secondary salinity is a measure of permanent hardness, secondary alkalinity of temporary hardness, tertiary salinity of acidity, primary alkalinity of permanent alkalinity, and primary salinity of saltness in the more popular acceptation of the term.

The water-classification scheme is based on the proportional reaction capacity of the five groups of radicles, and five classes of water result. The first class is characterized by primary salinity, primary alkalinity, and secondary alkalinity, and is exemplified in general by waters such as Lake Champlain and Oswegatchie River, derived mainly from igneous rocks. The second class is characterized by primary salinity and secondary alkalinity and is exemplified by waters such as Shenandoah River, derived from the older limestones. The third class is characterized by primary salinity, secondary salinity, and secondary alkalinity, and is exemplified by waters such as Miami and Maumee rivers, derived

from sedimentary rocks in general. The fourth class is characterized by primary and secondary salinity and is exemplified chiefly by highly concentrated waters such as brines and the ocean. The fifth class is characterized by primary, secondary, and tertiary salinity, and is exemplified by waters of peculiar origin, such as the mine-polluted Youghiogheny River.

There are presented studies of stream waters of southeastern United States, industrially important by reason of primary alkalinity, in which the influence of varied geology on character is clearly indicated; studies showing the persistence of high silica content in primary-alkaline waters; and studies of the mixing of waters of diverse character in the Laurentian and Mississippi River basins.

The conclusion that natural water may be definitely characterized if the mineral constituents are considered not as load but as a chemical system of balanced values is fully justified and the great value and wide application to water problems of the method of treatment is clearly shown. HERMAN STABLER.

CHEMISTRY.—*The determination of chromium and its separation from vanadium, in steels.* J. R. CAIN. Journal Industrial and Engineering Chemistry, **4**: 17, 1912. Technologic Paper No. 6, Bureau of Standards.

Sources of error in some of the usual methods for determining chromium in chrome or chrome-vanadium steels, which limit the accuracy of the results, are described.

The precipitation of chromium from solutions of steels and its separation from practically all the iron can be effected quickly and easily by boiling with a number of precipitants, herein described.

The chromium may be readily extracted from the precipitates by fusion, and separated from vanadium by precipitating as lead chromate under the conditions prescribed, the chromium being determined volumetrically in the lead chromate. J. R. C.

CHEMISTRY.—*A rapid method for the determination of vanadium in steels, ores, etc., based on its quantitative inclusion by the phospho-molybdate precipitate.* J. R. CAIN and J. C. HOSTETTER. To appear as Technologic Paper No. 8, Bureau of Standards. Also to appear in Journal Industrial and Engineering Chemistry.

1. It was found that vanadic acid may be quantitatively precipitated by ammonium phospho-molybdate.

2. The vanadium-bearing phospho-molybdate shows different solubility relations compared with normal phospho-molybdate with respect to the usual washing solutions used in determining phosphorus.

3. Conditions are given for quantitatively precipitating vanadic acid when in solution alone, or accompanied by a variety of other elements, by means of ammonium phospho-molybdate.

4. In order to determine quantitatively the vanadic acid so precipitated, (a) the possibility of freeing it from accompanying molybdic acid was investigated; (b) conditions for reducing it without reducing the associated molybdic acid were developed; and (c) a method for reducing it by hydrogen (and other) peroxides, and titrating it against permanganate was elaborated.

5. Method (c) was applied to a variety of steels, to iron ores, manganese ores, and to synthetic mixtures, in all of which the vanadium was determined accurately. J. R. C.

HYDROLOGY.—*Some stream waters of the western United States, with chapters on sediment carried by the Rio Grande and the industrial application of water analyses.* HERMAN STABLER. Water Supply Paper, U. S. Geological Survey No. 274. Pp. 188. 1911.

This paper presents the results of more than two years' analytical work at the Berkeley, Cal., laboratory of the U. S. Reclamation Service. The tables include mineral analyses of water from more than fifty important streams of western United States, samples having been collected daily for a period of one to two years, and miscellaneous analyses of water from streams, springs, lakes, wells and borings. With the analyses are tables of stream flow and estimates of daily discharge of suspended matter and dissolved solids. Analyses of the suspended matter carried by Colorado River and the Rio Grande are also included.

One chapter is devoted to a study of the quantity of sediment carried by the Rio Grande at the site of the proposed storage reservoir near Engle, N. Mex., the conclusion being that the probable mean annual discharge for a long term of years may variously be expressed as representing 11,300,000 tons of suspended matter, 3150 acre-feet of rock-matter, 5200 acre-feet of soil, 6110 acre-feet of compacted sediment, or 8650 acre-feet of freshly deposited sediment. Attention is called to the wide error likely to be introduced thru the customary method of making such estimates.

The final chapter is a study of the industrial application of water analyses stated in ionic form. Soap consumption; water softening; foaming, corrosion, and scale-formation in boilers; and irrigation value are

discussed in detail and formulas are presented to facilitate the evaluation and classification of waters with respect to these tendencies in quality. H. S.

GEOLOGY.—*Potash-bearing rocks of the Leucite Hills, Sweetwater County, Wyoming.* ALFRED R. SCHULTZ and WHITMAN CROSS. Bulletin U. S. Geological Survey, No. 512, p. 1 to 39, with maps.

The Rock Springs district in Sweetwater County, Wyoming, consists structurally of a low anticlinal dome of Cretaceous and Tertiary rocks plunging to the north and to the south. The major north-south axis is approximately 90 miles long and the width of the dome is about 50 miles. The beds on the west side of the anticline dip from 5° to 10°. From the central part of the dome have been removed all of the Tertiary Green River and Wasatch beds, the late Cretaceous ("Laramie"), and part of the Montana formations.

Resting on or cutting thru the sedimentary rocks in the north half of this dome are the Leucite Hills, composed of leucite-bearing lavas rich in potash. These lavas are certainly younger than the Green River beds and were presumably poured out on the more or less level plain upon which the Bishop conglomerate was deposited. The masses of leucite-bearing rock occur as dikes, sills, sheets, stocks and surface flows and rest upon or come in contact with Green River, Wasatch, "Laramie" and various formations of Montana age.

The lavas of the Leucite Hills contain on the average a larger percentage of potash than any other known igneous rocks. However, the extraction of the entire potash content of these rocks must be effected by a process applicable to leucite, sanidine, and phlogopite at least, and probably to other minerals, as the potash in the leucite-bearing rocks occurs in each of the above mentioned minerals. A. R. S.

GEOLOGY.—*The granites of Connecticut.* T. N. DALE and H. E. GREGORY. Bulletin U. S. Geological Survey No. 484. Pp. 137, with colored geologic map, 4 text maps, 8 figs., 6 pls. 1911.

To Part I, Gregory contributes a brief outline of the geology and geologic history of the State with brief descriptions of granite, granite-gneiss, pegmatite, porphyry, also paragraphs on granitic intrusions and the age of Connecticut granites and granite-gneisses which, with the exception of the Becket Gneiss, are regarded as post-Carboniferous. Dale has in the same part 18 pages on the structure, variation, discoloration, decomposition of granite, repeated from his previous granite bulletins, and a few observations on micro-structure, flow, inclusions, plicated

gneiss, dikes, mineral veins, contacts, etc. At the end of Part II, which is economic in character and is by Dale, the commercial granites of Connecticut are divided into 10 petrographic groups including 20 well-defined varieties. T. N. D.

GEOLOGY.—*Geologic atlas of the United States, Folio No. 175. Birmingham (Alabama) Folio.* CHARLES BUTTS. Maps and sections. 1911.

The Birmingham folio deals with an area of 1000 square miles. The broad surface features are the Birmingham and the Cahaba anticlinal valleys, with the low synclinal plateaus of the Chaba, Coosa, and Blount Mountain coal fields, with northeast-southwest trend, in the southeastern part; and the low plateau of the Warrior coal field in the northwestern part. The deeply dissected upland surfaces are probably remnants of the Cumberland plateau or peneplain (Schooley?), and the valleys may represent the Coosa peneplain.

The geologic section is as follows: Pottsville formation 2300–5100 feet; unconformity; Parkwood formation (new, Mississippian), shale and sandstone 200–2000; Pennington shale and Bangor limestone to northwest-Floyd shale to southeast, 1000 feet; Fort Payne chert 250 feet; unconformity; Chattanooga shale 20 feet; unconformity; Frog Mountain sandstone (Oriskany); unconformity (Helderbergian, Cayugan, and Niagaran absent); Clinton formation, sandstone and shale, with fossiliferous ore beds, 250–500 feet; unconformity (Cincinnatian and Mohawkian absent); Chickamauga limestone (mainly Chazyan) 200–450 feet; unconformity (Canadian absent in Birmingham valley); Knox dolomite, Ketona dolomite (new name) at base 3300 feet; uncomformity; Conasauga limestone 2000 feet; unconformity; Rome formation 500 feet.

The rocks are folded and faulted in the southeast and nearly flat in the northwest. The Warrior and Cahaba coal fields are bounded on the east by thrust faults, with displacement of 8000 to 10,000 feet, bringing the Cambrian into contact with the Pottsville. Minor thrust and normal faults occur also.

The principal mineral resources of the quadrangle are (1) coal, (2) iron ore, (3) limestone and dolomite, (4) shale, and (5) clay. The close association of the first three is the chief factor in the industrial prominence of the region. In the Warrior field are eight, and in the Cahaba field are two or more workable coal beds.

The iron ore is hematite, called red "fossil" ore on account of the abundant fossil shells which make it very calcareous. The weathered or "soft" ore carries 55 per cent metallic iron and 0.5 per cent lime, and the

deeper "hard" ore, 37 per cent metallic iron and 20 per cent lime. This composition of the "hard" ore holds from about 400 feet to the greatest depths reached, even to 2000 feet in bore holes over a mile from the outcrop. C. B.

GEOLOGY.—*The Sitka mining district, Alaska.* ADOLPH KNOPF. Bulletin U. S. Geological Survey, No. 504. Pp. 32, with maps and sections. 1912.

The Sitka mining district comprises Chichagof, Baranof, and Kruzof islands, together with a few smaller islands. The total land area roughly approximates 4500 square miles, the greater portion of which is included in Chichagof and Baranof islands.

The rocks lie in broad belts, which strike northwest and southeast, conforming thus with the prevailing structural trend of southeastern Alaska. The cores of the islands are made up largely of granitoid rocks, mainly quartz diorites, which, as a rule, have been intruded parallel to the stratified rocks.

The ore deposits are auriferous lodes, commonly occupying shear zones in graywacke. Two mines, both of which are situated at Klag Bay on the west coast of Chichagof Island, have so far been productive. The ores, which range in value from $15 to $90 a ton are of higher grade than the general gold ore of southeastern Alaska, which in 1910 averaged $2.78 a ton. A large number of ore bodies of the same general character have long been known to occur near Sitka, but owing to their low grade none has yet been brought to a producing stage. A. K.

ECONOMIC GEOLOGY.—*Coals of the State of Washington.* E. EGGLESTON SMITH. Bulletin U. S. Geological Survey, No. 474. Pp. 206, with maps and views. 1911.

Washington coals range from low-grade subbituminous to anthracite; but as the anthracite owes its character to metamorphism by igneous intrusions, it is of slight extent and limited range. In general, the highest grade of coal is found near the Cascade Range and the quality decreases westward from the mountains.

This is the first thoro systematic attempt to study the quality and character of the Washington coals. Every mine in the State was visited and from one to eight samples were obtained from each bed of coal mined, the samples being analyzed at the Pittsburgh Laboratory of the Bureau of Mines. Each mine is briefly described, and the location of each sample is recorded, with a section of the coal bed at that point. The physical characteristics of the coals and the effects of various impurities are fully treated

These data make it possible to compare the products of different mines or beds and to determine which is best adapted for any particular use. The investigation also shows the importance of careful preparation for the market, in the way of picking and washing.

M. R. CAMPBELL.

BOTANY.—*Three new plants from Alberta.* PAUL C. STANDLEY. Smithsonian Miscellaneous Collections, **56**[33]: 1–3. 1912.

The plants described are from a collection obtained in western Alberta and eastern British Columbia in the summer of 1911 by J. H. Riley and N. Hollister. *Vagnera pumila*, *Artemisia laevigata*, and *Gaillardia bracteosa* are described as new while one new combination, *Svida pubescens* ( = *Cornus pubescens* Nutt.) is formed. The Gaillardia is especially interesting, since it is the northernmost representative of the genus so far discovered. P. C. S.

BOTANY.—*A new leather flower from Illinois.* PAUL C. STANDLEY. Smithsonian Miscellaneous Collections, **56**[34]: 1–3, pl. 1. 1912.

*Viorna ridgwayi* is described from specimens collected by Mr. Robert Ridgeway in the summer of 1910 near Olney in southern Illinois. The species is related to *Viorna viorna*, the common leather flower, but is distinguished by the peculiar form of the leaves. A brief account is also given of the trees and shrubs of the locality from which the type comes. P. C. S.

BOTANY.—*Report on a collection of plants from the Pinacate region of Sonora.* J. N. ROSE and PAUL C. STANDLEY. Contributions from the U. S. National Herbarium, **16**: 5–20, fig. 1, pls. 3–16. 1912.

An annotated list is given of the plants collected by Dr. D. T. MacDougal in the Pinacate region during the autumn of 1907. The expedition during which these plants were collected is described by Dr. W. T. Hornaday in his book *Camp-Fires on Desert and Lava*. Altogether 83 species are listed, the type locality of each being given. Twelve new species are described, the most of which are illustrated by line drawings, and six new combinations are formed. J. N. R. and P. C. S.

BOTANY.—*Tumamoca, a new genus of Cucurbitaceae.* J. N. ROSE. Contributions from the U. S. National Herbarium, **16**: 21, pl. 17. 1912.

*Tumamoca macdougalii* represents a new genus of this family, allied to Ivervillea. The type was collected by Dr. D. T. MacDougal on Tumamoc Hill on which the Desert Laboratory of the Carnegie Institution is situated, near Tucson, Arizona. J. N. R.

# PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

## THE WASHINGTON ACADEMY OF SCIENCES

The 76th meeting of the Washington Academy of Sciences, a business meeting, was held at the Cosmos Club, 7:45 p.m., February 13, 1912, with President Coville in the chair.

The following were elected resident members:

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| R. V. Anderson | C. N. McBryde |
| E. S. Bastin | H. D. McCaskey |
| W. R. Calvert | F. H. Moffitt |
| R. L. Faris | Chase Palmer |
| N. C. Glover | E. W. Shaw |
| Karl F. Kellerman | Daniel W. Shea |
| Adolph Knopf | Herman Stabler |
| W. T. Lee | G. W. Stose |

W. J. HUMPHREYS, *Recording Secretary.*

The 77th meeting was held on February 13, 1912. Dr. L. A. BAUER gave an illustrated address on the *Recent work of the* Carnegie *and the total solar eclipse of April 28, 1911.* The speaker, enroute to Colombo, Ceylon, to join there the magnetic survey vessel, the *Carnegie*, under his charge, while awaiting connections at Suva, Fiji, for New Zealand, succeeded in getting into the belt of totality for the total solar eclipse of April 28, 1911. Since all the observing parties were to congregate at various points in the Tonga Islands, he thought it desirable to make the effort to reach some other point in order to multiply the chances of getting results. At the time that his official duties permitted him to leave Washington, viz., March 16, 1911, it could not be definitely ascertained that the necessary connections would be made at Suva, hence only a limited equipment was taken consisting of magnetic instruments to determine a possible effect on the earth's magnetism during the eclipse, and an improvised photographic apparatus. For the same reason it was not warranted to incur the expense of taking with him specially trained assistants, all the more so since every possible preparation had been made by the many astronomers in the Tonga Islands. The photographic apparatus had to be hastily improvised by Mr. Abbot, Director of the Astrophysical Observatory of the Smithsonian Institution; it consisted of a double-barreled, hand-driven, equatorially-mounted camera of about 11½-foot focus. The camera tubes, for convenience in packing, were made in three sections of stove pipe and the tripod in a similar manner of gas pipe. The entire equipment was packed in water tight cases to ensure against accidents, as landings on the islands chosen cannot always be effected safely on account of breakers.

Reaching Pago Pago, Tutuila, on April 24, he was transported, through the courtesy of His Excellency the Governor, Commander W. M. Crose, on the U. S. S. *Annapolis*, to Tau Island, the nearest accessible point in the belt of totality. This island is near the western edge of the belt, the approximate position of the station chosen being latitude 14°.2 S., longitude, 169°.6 W. In addition to putting the *Annapolis* at Dr. Bauer's disposal, Governor Crose also assigned to him several of his ablest officers.

The party arrived at the station late Wednesday afternoon, April 26, the remainder of the day being spent in selecting suitable points of observation and unpacking and assembling the instruments. The following day, April 27, was more or less cloudy and showers fell repeatedly thus hampering considerably the preparations for the morrow's work. However, the weather on the following day, April 28,—the day of the eclipse—was all that could be desired and so final preparations were made immediately. The photographic work was placed in charge of Lieutenant McDowell, U. S. N., aided by Dr. Connor and Messrs. Steffany and Reed. The times of contacts were observed by two independent parties, one aboard the *Annapolis*, anchored in Faleasau Bay, in charge of Lieutenant Baker, U. S. N., and the other ashore by Dr. Connor aided by Chaplain Pearce. The readings of the magnetic declination were made by Quartermaster Urle, Dr. Bauer assuming the general charge of the entire work, making the necessary astronomical observations for geographic position, azimuth and time, as well as determining the magnetic elements.

Owing to the inclement weather of the day before, it had not been possible to place the camera in final position so as to try out the finder until a few minutes before the eclipse, when it was unfortunately learned that the finder did not work satisfactorily and Lieutenant McDowell was accordingly obliged to improvise some simple device with the aid of which he might keep the sun's disk as central as possible on the photographic plates. For orientations of camera tubes in azimuth and altitude it was necessary to resort to the preliminary lines established by Dr. Bauer and his calculated azimuths and altitude of the sun for the totality phases. Four photographs of the eclipse were secured and upon development of the plates at Apia on May 3, it was found that the present corona fulfilled the expectations of chief development in the equatorial direction during the sunspot minimum. The totality began shortly after 10:00 a.m. and lasted $2^m3^s$ according to the ship party, and $1^m\ 59^s.5$ according to the shore party, which is as satisfactory an agreement as could be expected with the limited observing means. No member of the party observed visually the great equatorial extensions shown in the photographs. One of the observers aboard ship stated that he saw two stars. It is possible that although the sky was seemingly clear there may have been a fine haze sufficient to obscure the faint light from the coronal extensions. Perhaps due to the fact that the station was not far from the western edge of the belt of totality, it was not very dark at the time of totality, writing being easily read.

By special arrangement magnetic observations simultaneous with those at Tau Island were made at the five Coast and Geodetic Survey magnetic observatories, also at Melbourne, Christchurch, and Apia, where quick-run magnetograms were obtained for five hours. Until the records have been received from stations over the entire globe, it will not be possible to say definitely whether or not the present eclipse was accompanied by any minute and temporary change in the earth's magnetism.

The speaker referred appreciatively to the many courtesies extended and the valuable assistance rendered not only by Governor Crose and his able officers, but also by Queen Vaitupu and the Samoan chiefs who provided for the party's entertainment during their brief stay on the beautiful island of Tau. The *Annapolis* being required for other purposes, it was necessary to leave the station immediately after the eclipse work was over.

The speaker next gave a general account of the results of the work aboard the *Carnegie* on her present cruise, referring especially to the Indian Ocean portion on which comparatively large errors in the charts used by mariners were disclosed. Some statements pertaining to these corrections in the western half of the Indian Ocean have already been published in this Journal (1: 178–179. 1911). Serious errors have likewise been found since in the eastern part of the Indian Ocean. Special observations were also made for the definite location of the agonic line which passes through the Arabian Sea, Southern India and the Bay of Bengal. A preliminary draft of a new isogonic chart for the Indian Ocean as based upon the recent observations of the *Carnegie* was shown.

A brief account was likewise given of the present status of the magnetic operations of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington under the speaker's direction. The hope was expressed that, judging from the present rate of progress and with the coöperation of the various organizations engaged in magnetic work, it would be possible to issue a new set of magnetic charts for the entire globe within the next five years

Fuller publication with regard to the matters touched upon by the speaker will be made in the journal *Terrestrial Magnetism and Atmospheric Electricity*.

W. J. HUMPHREYS, *Recording Secretary*.

## PHILOSOPHICAL SOCIETY OF WASHINGTON

The 703rd meeting was held on January 27, 1912. Mr. W. J. HUMPHREYS, of the Weather Bureau, spoke on *Some scientific institutions at home and abroad*. An interesting account was given of a visit to a number of the scientific institutions of Great Britain and the Continent, and of how some of the scientific societies abroad are conducted, special mention being made of the British Association, the Royal Society of London, and the French Academy.

The activities were outlined of several meteorological bureaus, including those of Great Britain, Netherlands, Germany, Austria and France.

The speaker then mentioned the physical laboratories and astronomical and astrophysical observatories visited in England, Scotland, Holland France, Germany, Belgium and Austria, and spoke briefly of the men and the instrumental equipment at these institutions and the chief research work now being carried on by them.

Mr. N. E. DORSEY spoke informally of the recent absolute measurement of current at the Bureau of Standards and gave a few figures showing (1) the precision (something better than 1 in 1,000,000) attained in the determination of the ratio of the radii of two coils, (2) the relative constancy of the radii of 6 coils over a period of one year, and (3) the relative constancy of the standard cells used in that work.

R. L. FARIS, *Secretary.*

## THE CHEMICAL SOCIETY OF WASHINGTON

The 212th regular meeting was held at the Cosmos Club, January 11, 1912. President Le Clerc appointed the following committees for 1912: Program: Phelps, Seidell, Moore, McKelvy, Palmer. Entertainment: Boughton, Bunzel, Custis, Lathrop, Nothstine. P. H. Walker was elected local councilor. The following papers were read:

*Notes on the specific gravity of solids.* J. JOHNSTON and L. H. ADAMS of the Geophysical Laboratory. Read by Mr. Adams. Discussion by R. C. Wells, Boughton, Walker, Robinson and Byrnes.

*Pacific coast kelps.* J. W. TURRENTINE, Bureau Soils. Discussion by Dole, C. C. Moore, R. B. Moore, Herstein, Huston.

*Chemical investigation of American spearmint oil.* E. K. NELSON, Bureau Chemistry.

Note by Dr. P. A. YODER on *Marking of porcelain crucibles.*

Note by Dr. J. JOHNSTON exhibiting the *May-Nelson vacuum-pressure ring pump.*

A special meeting was held on January 25 in the Cosmos Club. Prof. EDWARD HART, of Lafayette College, gave a lecture on *Some early chemists.* It was illustrated by numerous reproductions from the lecturer's collection of rare books on chemistry and alchemy. A smoker followed the lecture.

The 213th regular meeting was held at the Cosmos Club on February 8. The following papers were read:

*A modification of the volumetric determination of phosphoric acid in phosphate rocks.* J. G. FAIRCHILD, Geological Survey (see this Journal, **2**: 114, 1912).

*Standardization of potassium permanganate by sodium oxalate.* R. S. MCBRIDE, Bureau Standards. Discussion by Foster, Johnston, Seidell, Hillebrand, Phelps, Waters.

*Refractive index of beeswax.* LEONARD FELDSTEIN, Bureau Chemistry.

*Quantitative oxidase studies.* H. H. BUNZEL, Bureau Plant Industry. Discussion by Waters and R. C. Wells.

ROBERT B. SOSMAN, *Acting Secretary.*